

Biological Instrumentation

A Quick Reference Guide

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This e-module serves as a comprehensive, quick-reference guide tailored for undergraduate and postgraduate students across Indian universities. Focusing on essential biological instruments, it simplifies complex apparatus through structured columns detailing working principles and practical functions. This concise handbook bridges theoretical knowledge and laboratory expertise, fostering academic excellence and seamless revision.

Sl	Biological Instrument	Working Principle	Function	Remarks
1	Autoclave	Moist heat sterilization under pressure (121°C, 15 psi)	Sterilizes media, glassware, instruments	Essential in microbiology labs
2	Analytical Balance	Electromagnetic force compensation	Measures very precise mass	High sensitivity (mg–µg range)
3	Agar Plate (Petri Dish setup)	Solid growth medium supports microbial growth	Culturing microorganisms	Used with incubator
4	Air Sampler	Air suction and particle trapping	Collects airborne microbes	Used in environmental studies
5	Anaerobic Jar	Oxygen removal using gas packs	Cultivation of anaerobic bacteria	Airtight system
6	Biosafety Cabinet	HEPA filtration and laminar airflow	Protects user and samples from contamination	Types I, II, III
7	Binocular Microscope	Light magnification using two eyepieces	Viewing specimens in 3D clarity	Common teaching microscope
8	BOD Incubator	Controlled temperature and humidity	Measures Biological Oxygen Demand	Used in water analysis
9	Blood Gas Analyzer	Electrochemical sensors	Measures pH, O ₂ , CO ₂ in blood	Clinical diagnostics

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10	Blotting Apparatus (Western/Southern)	Capillary transfer or electrophoresis	Transfers DNA/RNA/proteins to membrane	Used in molecular biology
11	Burette	Gravity-based liquid dispensing	Accurate titration of solutions	Used in biochemical analysis
12	Bunsen Burner	Gas combustion	Heating, sterilization	Basic lab instrument
13	Centrifuge	Centrifugal force separates components by density	Separates cells, organelles, proteins	RPM/RCF dependent
14	Colorimeter	Absorbance of specific wavelength (Beer-Lambert law)	Measures concentration of substances	Less sensitive than spectrophotometer
15	Cryostat	Low-temperature microtomy	Cuts thin frozen tissue sections	Used in histology
16	Chromatography Apparatus	Differential partitioning between phases	Separation of biomolecules	Types: TLC, HPLC, GC
17	Colony Counter	Optical/manual counting	Counts bacterial colonies	Used in microbiology
18	Conductivity Meter	Electrical conductivity measurement	Determines ionic concentration in solution	Water quality analysis
19	CO ₂ Incubator	Controlled CO ₂ and temperature	Cell culture growth	Maintains pH via CO ₂
20	DNA Sequencer	Fluorescence detection of nucleotides	Determines DNA sequence	Automated system
21	Distillation Unit	Differences in boiling point	Purifies liquids	Used for water purification
22	Dry Oven (Hot Air Oven)	Dry heat sterilization	Sterilizes glassware, metal instruments	160–180°C
23	Dialysis Apparatus	Semi-permeable membrane diffusion	Separation of small molecules from macromolecules	Used in biochemistry
24	Densitometer	Light absorption/scattering measurement	Quantifies bands in gels/blots	Used in molecular biology
25	Dissecting Microscope	Low magnification stereoscopic view	Study of larger specimens	Also called stereo microscope

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26	Electrophoresis Apparatus	Movement of charged particles in electric field	Separation of DNA, RNA, proteins	Agarose/PAGE types
27	ELISA Reader	Antigen–antibody reaction with color change	Detects proteins, hormones, pathogens	Microplate-based
28	Electron Microscope	Electron beam instead of light	Ultra-structure visualization	TEM/SEM types
29	Endoscope	Fiber optics and light transmission	Internal organ visualization	Medical use
30	Fermenter (Bioreactor)	Controlled biological reactions	Large-scale culture of microbes/cells	Industrial biotech
31	Fluorescence Microscope	Fluorophore excitation and emission	Study labeled cells/molecules	High specificity
32	Flow Cytometer	Laser-based cell analysis	Cell counting, sorting	Immunology research
33	Freeze Dryer (Lyophilizer)	Sublimation under vacuum	Preserves biological samples	Long-term storage
34	Gas Chromatograph	Separation based on volatility	Analyzes gases and volatile compounds	Coupled with MS
35	Gel Documentation System	UV/visible imaging	Visualizes DNA/protein bands	Used after electrophoresis
36	Hemocytometer	Grid-based manual counting	Counts cells (RBC, WBC)	Simple and cost-effective
37	High Performance Liquid Chromatography (HPLC)	High-pressure liquid separation	Purification and analysis	Highly sensitive
38	Hot Plate	Electrical heating	Heating samples	Basic lab use
39	Incubator	Controlled temperature	Growth of microorganisms	Fixed temperature
40	Inverted Microscope	Light from below	Cell culture observation	Used in tissue culture
41	Ion Chromatograph	Ion exchange separation	Detects ions in samples	Environmental analysis
42	Kjeldahl Apparatus	Nitrogen estimation via digestion	Protein estimation	Classical method
43	Laminar Air Flow	HEPA filtered airflow	Sterile working environment	Used in tissue culture
44	Light Microscope	Visible light magnification	Basic observation of cells	Most common
45	Magnetic Stirrer	Magnetic field	Mixes solutions	Often with heating

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		rotation		
46	Microtome	Mechanical sectioning	Thin tissue slices	Histology use
47	Micropipette	Air displacement	Accurate liquid measurement	µL range
48	Microplate Reader	Optical detection in plates	High-throughput assays	ELISA compatible
49	Nanodrop Spectrophotometer	UV absorbance (micro-volume)	DNA/RNA quantification	Needs very small sample
50	pH Meter	Electrode potential difference	Measures acidity/alkalinity	Calibration required
51	PCR Machine (Thermal Cycler)	DNA amplification cycles	Amplifies DNA	Molecular biology core tool
52	Phase Contrast Microscope	Light phase differences	Observes live cells	No staining needed
53	Polarimeter	Optical rotation	Measures chiral compounds	Biochemistry use
54	Refractometer	Light refraction	Measures concentration/RI	Sugar, protein estimation
55	Respirometer	Oxygen consumption	Measures respiration rate	Physiology studies
56	Rotary Evaporator	Vacuum evaporation	Solvent removal	Chemical labs
57	Spectrophotometer	Light absorbance (Beer-Lambert law)	Quantifies biomolecules	Widely used
58	Spectrofluorometer	Fluorescence emission	Detects low concentration molecules	Very sensitive
59	Soxhlet Apparatus	Continuous solvent extraction	Extracts lipids	Classical method
60	Thermocycler	Temperature cycling	DNA amplification (PCR)	Same as PCR machine
61	Ultracentrifuge	Very high-speed centrifugation	Separates macromolecules	High precision
62	Ultrasonic Homogenizer	Ultrasonic waves disruption	Breaks cells	Sample preparation
63	UV Transilluminator	UV light excitation	Visualizes DNA bands	Used with gels
64	Vacuum Pump	Pressure reduction	Filtration, drying	Lab support tool
65	Vortex Mixer	Rapid circular motion	Mixes samples quickly	Small volumes
66	Water Bath	Controlled heating via water	Incubation at constant temp	Gentle heating
67	Western Blot Apparatus	Protein transfer +	Identifies proteins	Molecular biology

Sl	Biological Instrument	Working Principle	Function	Remarks
		antibody detection		
68	X-ray Diffraction (XRD)	X-ray scattering	Structure determination	Crystallography
69	X-ray Microtomography	X-ray imaging	3D internal structure	Non-destructive
70	Yeast Fermentation Apparatus	Fermentation process	Studies yeast metabolism	Educational labs
71	Zeta Potential Analyzer	Particle charge measurement	Stability of colloids	Nanobiotech use
